

REMARKS

Claims 1-219, 221-234 and 236-311 are pending in the Application prior to the amendments herein.¹

Claims 1-219, 221-234 and 236-311 are rejected.

Claims 1, 4, 78, 150, 151, 230, 234, 238 and 240 are amended herein. Support for the amendments to Claims 1, 78, 150 and 230 is given in the Application at page 11, lines 1-4. The amendments to Claims 4, 151, 234 and 238 are to provide consistency with the independent claims from which they depend. The amendment to Claim 240 is to correct a grammatical error.

Claims 221-229 are cancelled.

Claims 1-219, 230-234 and 236-311 are pending after entry of the amendments herein.

1. Objections to Drawings.

The Examiner has objected to Figures 5-6 and 13-16 because the features/details are not viewable. The applicant has enhanced the contrast and/or brightness of the pictures such that the features are now viewable. Replacement sheets for Figures 5-6 and 13-16 are attached.

2. Rejections Under 35 U.S.C. § 102(e)/103(a) over Resasco

The Examiner has rejected Claims 1-16, 20-53, 230-234, 236-246 and 252-291 under 35 U.S.C. § 102(e) as being anticipated by or, in the alternative, under U.S.C. § 103(a) as obvious over Resasco et al., U.S. Patent 6,413,487 (“*Resasco*”). Office Action at 2.

¹ Note that Applicant cancelled Claims 220 and 235 in the reply to the first Office Action mailed November 17, 2005. Thus, the claims pending before entering any amendments herein are Claims 1-219, 221-234 and 236-311.

The Examiner contends that “*Resasco* teaches [a] method for producing single-wall carbon nanotubes using a supported bi-metal metal catalyst of at least one metal from both group VIIIB and VIB. Iron, Co & Mo are all taught as catalytic metals on MgO (see claim 23). *Resasco* teaches the claimed ratios of metals, reducing the metal with hydrogen before contacting, and teaches contacting the catalyst with methane with hydrogen for a short period of time at the claimed temperatures to produce substantially pure single-wall nanotubes, then using HCl to remove the catalyst. While *Resasco* does not teach the same method of combusting precursors of the catalytic metals, the resulting product appears to be the same.” Office Action at 2-3.

Applicant respectfully traverses the rejection. Anticipation requires each and every element of the claim to be found within the cited prior art reference. To establish a *prima facie* case of obviousness, at least three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference. Second, there must be a reasonable expectation of success. Finally, the prior art reference or references must teach or suggest all the claim limitations.

Claims 1 and 230 have been amended to require, *inter alia*, a catalyst comprising a solid solution of catalytic metal comprising iron oxide, molybdenum oxide and magnesium oxide.

Resasco does not teach or suggest a catalyst comprising a solid solution of catalytic metal comprising iron oxide, molybdenum oxide and magnesium oxide prepared by combusting. Thus, as *Resasco* does not teach or suggest each and every element of amended Claims 1 and 230, Applicant respectfully asserts that Claims 1 and 230 are not anticipated by, nor obvious over *Resasco*.

Claim 4 has been amended for consistency with the antecedent basis provided by Claim 1 and Claims 234 and 238 have been amended for consistency with Claim 230.

Claims 2-16 and 20-53 are directly or indirectly dependent upon amended Claim 1 and are neither anticipated by, nor obvious over *Resasco* for the same reasons that amended Claim 1 is not anticipated or obvious.

Claims 231-234, 236-246, and 252-291 are directly or indirectly dependent upon amended Claim 230 and are neither anticipated by, nor obvious over *Resasco* for the same reasons that amended Claim 230 is not anticipated or obvious.

Therefore, in light of the foregoing, Applicant respectfully requests that the Examiner withdraw his rejection of Claims 1-16, 230-234, 236-246 and 252-291 under 35 U.S.C. § 102(e) as being anticipated by or, in the alternative, under U.S.C. § 103(a) as obvious over *Resasco*.

3. Rejections Under 35 U.S.C. § 103(a) over Resasco in View of Smalley

The Examiner has rejected Claims 17-20, 78-125, 150-195 and 247-251 under 35 U.S.C. § 103(a) as being unpatentable over *Resasco* as applied above in view of Smalley et al., U.S. Patent 6,761,870 (“*Smalley*”). Office Action at 2.

Applicant respectfully traverses the rejections.

The Examiner contends that “Resasco does not teach sulfiding the catalyst. Smalley teaches a method of making single-wall carbon nanotubes using the same catalytic metals (bottom of column 3) as catalyst particles, but does not use a support. The nanotube growth step of Smalley is similar to that of Resasco in the use of temperature, feedstock, and resulting purity, among other analogous properties. Smalley teaches using thiophene and H₂S as sulfiding agents. It would have been obvious to one of ordinary skill in the art to use these agents in the process of

Resasco in order to, as Smalley teaches, fine tune the activity of the catalyst (Column 13, first paragraph).” Office Action at 3.

Claims 17-20 are dependent upon amended Claim 1 which now requires, *inter alia*, the element of “a catalyst comprising a solid solution of catalytic metal comprising iron oxide, molybdenum oxide and magnesium oxide.” Neither *Resasco* nor *Smalley*, either alone or in combination, teaches or suggests this element. Furthermore, even if the teachings of *Resasco* and *Smalley* were combined, they would not teach or suggest all the claim limitations. Thus, a case of *prima facie* obviousness has not been established as to Claims 17-20.

Claim 78 has been amended to require, *inter alia*, the element of “a catalyst comprising a solid solution comprising catalytic metal comprising at least one metal from the group consisting of Group VIB and Group VIIIB and a support selected from the group consisting of oxides of aluminum, magnesium, silicon, zirconium and combinations thereof.” Neither *Resasco* nor *Smalley*, either alone or in combination, teaches or suggests this element.

Claims 79-125 are directly or indirectly dependent upon amended Claim 78 and are neither anticipated by, nor obvious over *Resasco* in view of *Smalley*, for the same reasons that amended Claim 78 is not anticipated or obvious.

Claim 150 has been amended to require, *inter alia*, the element of “a catalyst of catalytic metal comprising a solid solution comprising cobalt oxide, molybdenum oxide and magnesium oxide.” Neither *Resasco* nor *Smalley*, either alone or in combination, teaches or suggests this element. Claim 151 has been amended for consistency with the antecedent basis provided by Claim 150.

Claims 151-195 are directly or indirectly dependent upon amended Claim 150 and are neither anticipated by, nor obvious over *Resasco* in view of *Smalley*, for the same reasons that amended Claim 150 is not anticipated or obvious.

Claims 247-251 are dependent upon amended Claim 230 which now requires, *inter alia*, the element of “a supported catalyst comprising a solid solution of catalytic metal comprising iron oxide, molybdenum oxide and magnesium oxide.” Neither *Resasco* nor *Smalley*, either alone or in combination, teaches or suggests this element. Furthermore, even if the teachings of *Resasco* and *Smalley* were combined, they would not teach or suggest all the claim limitations. Thus, a case of *prima facie* obviousness has not been established as to Claims 247-251.

Therefore, in light of the foregoing, Applicant respectfully requests that the Examiner withdraw his rejection of Claims 17-20, 78-125, 150-195 and 247-251 under 35 U.S.C. § 103(a) as being unpatentable over *Resasco* as applied above in view of *Smalley*.

4. Rejections Under 35 U.S.C. § 103(a) over Resasco and Smalley in View of Yamada

The Examiner has rejected Claims 54-77, 126-149, 196-219, 221-229 and 292-311 under 35 U.S.C. § 103(a) as being unpatentable over *Resasco* et al. and *Smalley* et al. as applied above and further in view of Yamada et al. (U.S. Patent 5,102,647) (“*Yamada*”). Office Action at 3-4.

The Examiner contends that “Neither *Resasco* nor *Smalley* teach using fluidizing aid particles in the reactor. *Yamada* teaches a process for growing carbon fibers on catalyst particles while using ceramic particles as a fluidizing aid. *Yamada* teaches several ways of using the particles and teaches removing them separately and recycling them for reuse. *Yamada* also teaches using a counter-current flow method in the reactor. It would have been obvious to one of ordinary skill in the art at the time of the invention to use the ceramic particles in the processes

of Resasco & Smalley in order to detangle the nanotubes and/or improve heat dispersion of the reaction as taught by Yamada, and to use counter-current flow to increase the interaction of the reactants and catalyst particles. The different variations of the claims are obvious variations that one of ordinary skill in reactor apparatus and fluidizing aid art would recognize as obvious and are not seen as patentably distinct." (Office Action at 4-5)

Claims 54-77 are dependent upon amended Claim 1 which now requires, *inter alia*, the element of "a supported catalyst comprising a solid solution of catalytic metal comprising iron oxide, molybdenum oxide and magnesium oxide." Neither *Resasco*, *Smalley*, nor *Yamada*, either alone or in combination, teaches or suggests this element. Furthermore, even if the teachings of *Resasco*, *Smalley* and *Yamada* were combined, they would not teach or suggest all the claim limitations. Thus, a case of *prima facie* obviousness has not been established as to Claims 54-77.

Claims 126-148 are dependent upon amended Claim 78 which now requires, *inter alia*, the element of "a catalyst comprising a solid solution comprising catalytic metal comprising at least one metal from the group consisting of Group VIB and Group VIIIB and a support selected from the group consisting of oxides of aluminum, magnesium, silicon, zirconium and combinations thereof." Neither *Resasco*, *Smalley*, nor *Yamada*, either alone or in combination, teaches or suggests this element. Furthermore, even if the teachings of *Resasco*, *Smalley* and *Yamada* were combined, they would not teach or suggest all the claim limitations. Thus, a case of *prima facie* obviousness has not been established as to Claims 126-148.

Claims 196-219 are dependent upon amended Claim 150 which now requires, *inter alia*, the element of "a catalyst which is a solid solution." Neither *Resasco*, *Smalley*, nor *Yamada*, either alone or in combination, teaches or suggests this element. Furthermore, even if the

teachings of *Resasco*, *Smalley* and *Yamada* were combined, they would not teach or suggest all the claim limitations. Thus, a case of *prima facie* obviousness has not been established as to Claims 196-219.

Claims 221-229 have been cancelled and the rejection of these claims is now moot.

Claims 292-311 are directly or indirectly dependent upon amended Claim 230 which has been amended to further require, *inter alia*, the element of “a supported comprising a solid solution of catalytic metal comprising iron oxide, molybdenum oxide and magnesium oxide.” Neither *Resasco*, *Smalley*, nor *Yamada*, either alone or in combination, teaches or suggests this element. Furthermore, even if the teachings of *Resasco*, *Smalley* and *Yamada* were combined, they would not teach or suggest all the claim limitations. Thus, a case of *prima facie* obviousness has not been established as to Claims 292-311.

Therefore, Applicant respectfully requests that the Examiner withdraw his rejection of Claims 54-77, 126-149, 196-219 and 292-311 under 35 U.S.C. § 103(a) as being unpatentable over *Resasco* and *Smalley* as applied above and further in view of *Yamada*.

5. Conclusion

As a result of the foregoing, Applicant asserts that the Claims are now in condition for allowance.

The Examiner is invited to contact the undersigned attorney at (713) 934-4094 with any questions, comments or suggestions relating to the referenced patent application.

Respectfully submitted,

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